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# *Metopograpsus oceanicus* (Crustacea: Brachyura) in Hawai'i and Guam: Another Recent Invasive?<sup>1</sup>

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**Abstract:** The grapsid crab *Metopograpsus oceanicus* (Jacquinot, 1852) is recorded from the Hawaiian Islands for the first time; it appears to be established at least in Kāne'ohe Bay on O'ahu. I review the ecology of the species in Oceania and argue that it was introduced both to the Hawaiian Islands and Guam, likely by shipping traffic. A brief review of *Metopograpsus* in the Hawaiian Islands is also presented.

INVASIONS BY nonindigenous species are one of the greatest threats to island ecosystems. Although nonindigenous species remain less common in the sea than on land, hundreds of marine species have become established in U.S. waters, including the Hawaiian Islands (Coles et al. 1999, 2002, Ruiz et al. 1997, 2000). Marine invasions are most prevalent in estuaries, lagoons, and other large enclosed marine systems favored for harbors and home to specialized biotas. In these habitats nonindigenous species are now often major and even dominant components of the biota, with cascading impacts on trophic webs, community structure, and survival of indigenous species (e.g., Lee et al. 2003, Thompson 2005).

Marine nonindigenous species on Pacific islands remain understudied, although several surveys over the past decade have increased our knowledge greatly. In Oceania the Hawaiian Islands (Coles et al. 1999, 2002, 2006, and others), American Samoa (Coles et al. 2003), and Guam (Paulay et al. 1997, 2002) are best documented for nonindigenous spe-

cies. In both Hawai'i and Guam many non-indigenous species remain limited to large lagoonal systems (Paulay et al. 2002, Coles et al. 2006). In the Mariana Islands, Apra Harbor on Guam is the only deep-water lagoon, and the majority of nonindigenous species in the archipelago are known from there (Paulay et al. 2002). In the Hawaiian Islands most invaders have become established in Pearl Harbor and Kāne'ohe Bay on O'ahu, the only deep-water lagoon systems in the main Hawaiian Islands (Coles et al. 1999, 2002).

Carlton (1996) suggested several lines of evidence that can be used to recognize nonindigenous species, with appearance of a species in a well-studied biota being the most direct and convincing. Hawaiian invertebrates have received uneven attention, with most taxa substantially understudied, limiting the efficacy of this criterion in many groups. Near-shore brachyuran crabs, however, are among the best known, thanks to the detailed study provided them during the middle of the twentieth century by C. H. Edmondson, the most prolific worker on Hawaiian marine invertebrates.

Genus *Metopograpsus* H. Milne Edwards, 1853

Six species are recognized in the most recent revision of *Metopograpsus* (Banerjee 1960), two of which have been recorded from the Hawaiian Islands: *Metopograpsus thukubar* (Owen, 1839) and *Metopograpsus messor* (Forsskal, 1775) (Edmondson 1959). The distinction between these crabs is subtle, and both Tweedie (1949) and Banerjee (1960) considered *M.*

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*messor* to be restricted to the western Indian Ocean. Edmondson's (1959) conclusion that both are present in the Hawaiian Islands was based on his observation that the antennal flagellum was excluded from the orbital hiatus (*M. messor*) in most specimens but entered it in some (*M. thukubar*). Edmondson's (1959) figure of the first male pleopod of his *M. messor*, however, matches the distinctive gonopod of *M. thukubar* (compare his fig. 7b with Tweedie's [1949] fig. 1f), suggesting that probably only a single, variable species is represented. The two males from Hawai'i available to me (UF 2126) both have an open orbital hiatus and typical *M. thukubar* gonopods. Additional specimens and study are needed to evaluate whether one variable or two species occur in Hawai'i. Poupin (1994, 1996, 2006) made a similar observation regarding the purported occurrence of these two species in French Polynesia; again all recent, reliable records pertain to *M. thukubar*. Similarly, all Pacific material on hand at the Florida Museum of Natural History (University of Florida: UF) for this complex, including specimens from the Philippines, Mariana, Fiji, Tuvalu, Caroline, Society, Tuamotu, and Gambier Islands, pertain to *M. thukubar*. It is interesting to note that the inclusion versus exclusion of the antennae from the orbital hiatus is the classical character distinguishing *Pachygrapsus* (included) from *Metopograpsus* (excluded), even though *Metopograpsus* is variable in this regard; the distinction between these genera clearly requires study (Poupin et al. 2005).

#### MATERIALS AND METHODS

During a visit to the Hawai'i Institute of Marine Biology in February 2006, I had a chance to look briefly at nearshore invertebrates on Coconut Island in Kāne'ohe Bay. Reef-flat and shore habitats were searched during one

night and one day low tide, mostly around the ocean side of the islet, and 16 crab species and some other invertebrates collected. One of the crabs encountered, *Metopograpsus oceanicus*, represents a new record for the Hawaiian Islands and appears to be a recently established invasive. The species was identified based on Tweedie (1949) and Banerjee (1960) and also compared with holdings at UF previously identified from the same sources.

#### RESULTS

##### *Metopograpsus oceanicus* (Jacquinot, 1852) Figure 1A,B,C,E,F

Two species of *Metopograpsus* have an anterolateral tooth behind the exorbital tooth: *M. oceanicus* and *M. quadridentatus* Stimpson, 1858 (Banerjee 1960). *Metopograpsus oceanicus* can be readily distinguished by a characteristic row of setae on the posterior surface of the propodus and dactylus of the first three walking legs (Figure 1B); by an acute and keeled, rather than obtuse and unkeeled, sub-orbital tooth; as well as by its distinctive first male pleopod, with a short, terminal, trumpetlike, flared, corneous extension (Figure 1E, Tweedie 1949, Banerjee 1960). All material examined, including the Hawaiian specimens, are typical *M. oceanicus*. This species tends to be darker than *M. messor* (Figure 1D); it is mottled in black, brown, and light tan. Chelae (Figure 1F) are violet in life as in *M. thukubar* but lack the light spotting that characterizes claws of the latter. *Metopograpsus oceanicus* has a distinctly trapezoidal, posteriorly narrowing carapace, whereas that of *M. thukubar* is more quadrate. The distinctive shape and color allow rapid field separation of the two, even from a distance.

**MATERIAL EXAMINED.** UF 8605: O'ahu, Coconut Island, supratidal, on concrete retaining wall of interior lagoon at night, 28

FIGURE 1. *Metopograpsus oceanicus* (A,B,C,E,F), *M. thukubar* (D). A, *M. oceanicus* female (UF 8605); note extra anterolateral tooth on carapace (arrow). B, Close-up of right second walking leg of (A); note row of setae in groove on propodus and dactylus (arrow). C, *M. oceanicus* male (UF 8606). D, *M. thukubar* female (UF 8608). E, 1st pleopod of (C). F, Ventral view of (C); note lack of spotting on chela. Scale bar: 1 cm (A, C, D). All habitus photos are of fresh animals from Coconut Island.

February 2006, coll. G. Paulay, 1 female, carapace width 31 mm, carapace length 25 mm (Figure 1A,B).

UF 8606: O'ahu, Coconut Island, supratidal on prop root of *Rhizophora mangle*, 3 March 2006, coll. G. Paulay, male, carapace width 26 mm, carapace length 20 mm (Figure 1C,E,F).

UF 105: Guam, Apra Harbor, inner harbor mooring buoy, 16 September 1998, coll. G. Paulay, 2 females, 1 male.

UF 103: Guam, Apra Harbor, W face of Drydock Island, above waterline on wharf, 6 October 1996, coll. G. Paulay, 3 males.

UF 3172: Guam, Apra Harbor, on mooring buoy 16, 13° 26.74' N, 144° 38.54' E, 23 August 2000, coll. G. Paulay, 1 female, 3 males.

UF 2280: Palau Islands, Iwayama Bay System: cave in bay past Omodes, 17 March 1996, coll. G. Paulay, 1 male.

UF 3811: Palau, Iwayama Bay System: hidden cove along N shore of Ulebeschel Island, "Bay of the Dragon Palace," supratidal in notch on limestone, 7° 18.81' N, 134° 29.25' E, 5 March 2003, coll. G. Paulay, 5 males, 5 females.

UF 3815: Palau, Iwayama Bay System: N side of strait between Ngeteklou and Ngermeuangel Islands, intertidal/supratidal, 7° 19.2' N, 134° 29.78' E, 5 March 2003, coll. G. Paulay, 2 males.

UF 3817: Palau, Iwayama Bay System: hidden cove along N shore of Ulebeschel Island, "Bay of the Dragon Palace," supratidal in notch on limestone, 7° 18.81' N, 134° 29.25' E, 5 March 2003, coll. G. Paulay, 1 male, photographed.

#### DISCUSSION

Until recently the known range of *Metopograpsus oceanicus* was from East Africa to the Philippines (Banerjee 1960). Takeda (1989) since recorded the species from Palau, and we have recorded it from Guam (Paulay et al. 1997, 2002, 2003). I am not aware of any other published records in Oceania and, other than this new record, have not come across the species elsewhere in the region.

We considered this species cryptogenic on Guam but did not review it in the checklist-

based publications already mentioned, so a brief summary of its occurrence on Guam is presented here. *Metopograpsus oceanicus* was encountered only in Apra Harbor, even though extensive biodiversity surveys were carried out around much of the island. In Apra Harbor it was largely localized to artificial substrata: concrete seawalls, sides of large vessels, and navigational and mooring buoys. It was locally common on these substrata in the most-protected, landward parts of Apra Harbor, usually on vertical or near-vertical surfaces, 0–2 m above the waterline, running rapidly when disturbed. I saw it in four areas of Apra Harbor: (1) the extensively modified Inner Harbor, which serves as the major military port on Guam, where it was common on wharf walls; (2) Drydock Island Peninsula, where it was common on seawalls and wharves; (3) the northeastern harbor around the commercial port and Piti channel, where again it was encountered on seawalls; and (4) on navigational buoys in the eastern end of the main body of Apra Harbor (Paulay et al. 1997). I first encountered this species in 1997 during a survey of the harbor, when it was already common there. I had not searched appropriate habitat before that time. The species appears to be absent from the intertidal to supratidal karstic cliffs that bound much of Guam, a habitat that we have studied extensively for crabs and other invertebrates. This makes an interesting contrast with Palau (see later in this section). In the limited effort spent studying mangrove biota on Guam we did not encounter *M. oceanicus* but found the related *Metopograpsus latifrons* (White, 1874) on *Rhizophora* roots. This latter species was not treated in Paulay et al. (2002) as potentially introduced but deserves consideration. On the basis of the almost exclusive association of *M. oceanicus* with artificial substrata (including the hull of moored ships), its restriction to the main harbor on Guam, and this record being an eastern extension of the previously documented range of the species, we considered it to be potentially introduced, or cryptogenic, on Guam.

*Metopograpsus oceanicus* is locally common in Palau above the waterline on notched, steep, karstic shores in protected embay-

ments. In the maze of bays and waterways surrounding Koror, known during the Japanese period as "Iwayama Bay," this species is the dominant crab out in the open in the upper intertidal to supratidal zone. This area is completely protected from storm surge and wave action and thus represents a very different habitat than the superficially similar karstic cliffs that surround much of Guam, which are largely exposed to the open sea, fronted only by benches and reef flats. The species thus appears to require both shelter from oceanic exposure and steep solid substrata, provided by natural shores in Palau and artificial shores on Guam. It is noteworthy that all three species of *Metopograpsus* I have encountered in Oceania, *M. latifrons*, *M. oceanicus*, and *M. thukubar*, appear to be limited to such protected, often silty areas, often under estuarine influence. The occurrence of *M. oceanicus* on Palau is thus compatible with natural occurrence.

On Coconut Island in Kāneʻohe Bay, *M. oceanicus* was encountered in a similar setting. One specimen was taken above the water on a vertical seawall facing an artificial lagoon, the other on prop roots of the introduced mangrove *Rhizophora mangle*. In the former habitat it co-occurred with abundant *M. thukubar*; in the latter only a single animal was seen. *Metopograpsus thukubar* is more common, but I saw several *M. oceanicus* as well. No quantification of the abundance of either species was attempted.

Edmondson (1959) reviewed the Hawaiian Grapsidae and did not mention *M. oceanicus*. The species is sufficiently distinct, especially by its extra anterolateral tooth, that it is highly unlikely that Edmondson would have missed noting it had he seen it in Hawai'i. Given that this is a large, intertidal, exposed, active, diurnal species, it is likely that it was not yet established in Hawai'i during Edmondson's time. Since the 1960s there has been but limited effort to document the crab fauna of Hawai'i, and *M. oceanicus* could have become established at any time. Evidence that it is likely introduced includes, in addition to its potentially new appearance on O'ahu, its association with artificial and introduced (mangrove) substrata, its affinity for ship

hulls, and absence of documented records anywhere else on the Pacific Plate. The presence of several adult specimens in 2006 suggests that the species is now established, at least in Kāneʻohe Bay. Additional surveys are needed to assess its occurrence around the archipelago. Given the crab's ecology, Pearl Harbor is an especially likely potential habitat, as are other protected areas with vertical shores or mangroves.

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